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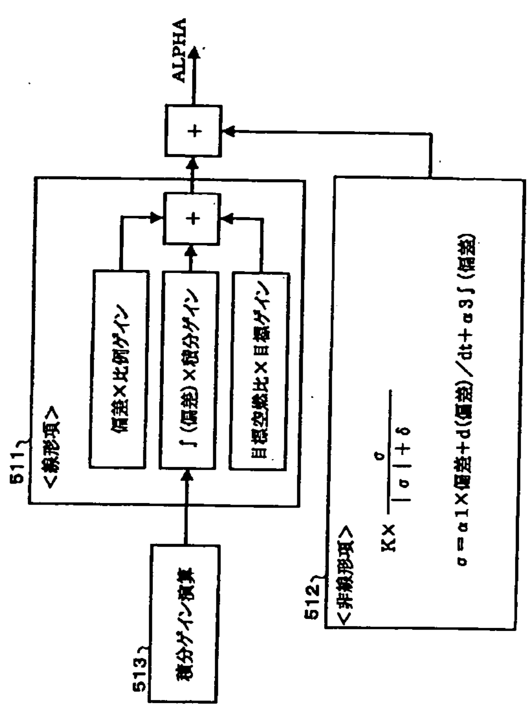
(54)【発明の名称】内燃機関の空燃比フィードバック制御装置

(57)【要約】
【課題】スライディングモードを用いる空燃比フィードバック制御において、定常偏差を解消しつつ、外乱の投入・解除時における空燃比の収束性を確保できるようにする。
【解決手段】実空燃比と目標空燃比との偏差と比例ゲインから比例項を算出し、前記偏差と積分ゲインから積分項を算出し、これらの総和を線形項Ｕ１とする。一方、切換え関数σを、空燃比偏差、偏差の微分値、偏差の積分値を変数として設定して、非線形項Ｕ２を算出させる。ここで、前記積分ゲインを、空燃比偏差の絶対値が大きいときほど大きな値に補正することで、外乱の投入による空燃比ずれが発生したときの積分項の溜め込みを速め、また、外乱が解除されたときの積分項の吐き出しを速める。



の積分値に乗算される積分ゲインは一定ではなく、空燃比偏差に応じて補正され、目標空燃比に対する実空燃比の偏差や変化の方向の情報から積分ゲインが変更される。

【００１０】請求項５記載の発明では、積分ゲインを、空燃比偏差の絶対値に応じて補正する構成とした。かかる構成によると、実空燃比が目標空燃比に対してリッチ或いはリーン方向にどれだけ離れているかによって、積分ゲインが補正される。請求項６記載の発明では、空燃比偏差の絶対値が大きいときほど、積分ゲインをより大きな値に補正する構成とした。

【００１１】かかる構成によると、実空燃比が目標空燃比に対してリッチ或いはリーン方向に大きく離れているときほど、積分ゲインが大きく補正され、空燃比偏差の積分値に対して得られる積分項の絶対値が大きくなる。請求項７記載の発明では、積分ゲインを、空燃比偏差の変化率に応じて補正する構成とした。

【００１２】かかる構成によると、積分ゲインが、目標空燃比に対する実空燃比の変化方向及び変化速度を示す空燃比偏差の変化率に応じて補正される。尚、前記変化率とは、空燃比偏差の単位時間当たりの変化量である。請求項８記載の発明では、空燃比偏差の変化率の符号と、空燃比偏差の符号とが同じであるときに、積分ゲインを増大補正する構成とした。

【００１３】かかる構成によると、空燃比偏差の符号と変化率の符号とが同じ状態は、例えば目標空燃比よりも実空燃比がリーンであるのに、実空燃比が更にリーン変化している状態であって、空燃比偏差が拡大する傾向にある状態であり、係る状態で積分ゲインが増大補正される。請求項９記載の発明では、空燃比偏差の変化率の絶対値が大きいときほど、積分ゲインをより大きく増大補正する構成とした。

【００１４】かかる構成によると、空燃比偏差が拡大する傾向にあるときに、目標空燃比から離れる速度が速いときほど、積分ゲインを増大補正する。請求項１０記載の発明では、積分ゲインを、空燃比偏差の絶対値の変化率に応じて補正する構成とした。かかる構成によると、空燃比偏差の絶対値を求めることで、実空燃比が目標空燃比に対してリッチであるかリーンであるかとは無関係に目標空燃比に対する空燃比偏差が求められ、この偏差の絶対値の変化率は、プラスであれば空燃比偏差が拡大していることになり、逆にマイナスであれば空燃比偏差が縮小して目標空燃比に向かって変化していることになり、これに応じて積分ゲインが変更される。

【００１５】

【発明の効果】請求項１記載の発明によると、スライディングモード制御における線形項に積分項を含めることで、外乱の影響を抑制したロバスト性の高い制御を行わせつつ、空燃比の定常偏差を解消することができるという効果がある。請求項２記載の発明によると、比例項と

積分項とから線形項を算出させることで、定常偏差を解消できると共に、むだ時間の多い空燃比フィードバック制御における安定性を確保できるという効果がある。

【００１６】請求項３記載の発明によると、空燃比偏差，空燃比偏差の積分値，空燃比偏差の微分値を所定の平衡状態に保ちつつ目標空燃比に近づけることができるという効果がある。請求項４記載の発明によると、積分項の演算に用いる積分ゲインを空燃比偏差に応じて補正することで、実空燃比の変動に応じた適正な積分ゲインの設定が可能になり、積分項の溜め込み・吐き出し速度を最適にして目標空燃比への収束性を高めることができるという効果がある。

【００１７】請求項５，６記載の発明によると、目標空燃比に対して実空燃比が離れるほど積分ゲインを大きくすることで、積分項の溜め込み・吐き出し速度を速め、実空燃比を目標空燃比に応答良く戻せるという効果がある。請求項７記載の発明によると、空燃比偏差の変化方向・変化速度の情報に基づき積分ゲインを適正に補正でき、以って、積分項の溜め込み・吐き出し速度を最適にして目標空燃比への収束性を高めることができるという効果がある。

【００１８】請求項８，９，１０記載の発明によると、空燃比偏差が拡大傾向にあるときに積分ゲインを大きく補正して、積分項の溜め込み・吐き出し速度を速くし、実空燃比を目標空燃比に速やかに収束させることができるという効果がある。

【００１９】

【発明の実施の形態】以下に本発明の実施の形態を説明する。図１は実施の形態における内燃機関のシステム構成図である。この図１において、車両に搭載される内燃機関１の各気筒の燃焼室には、エアクリーナ２，吸気通路３，モータで開閉駆動される電子制御式スロットル弁４を介して空気が吸入される。

【００２０】各気筒の燃焼室内に燃料（ガソリン）を直接噴射する電磁式の燃料噴射弁５が設けられており、該燃料噴射弁５から噴射される燃料と前記吸入される空気とによって燃焼室内に混合気が形成される。燃料噴射弁５は、コントロールユニット２０から出力される噴射パルス信号によりソレノイドに通電されて開弁し、所定圧力に調圧された燃料を噴射する。そして、噴射された燃料は、吸気行程噴射の場合は燃焼室内に拡散して均質な混合気を形成し、また圧縮行程噴射の場合は点火栓６回りに集中的に層状の混合気を形成する。燃焼室内に形成される混合気は、点火栓６により着火燃焼する。

【００２１】但し、内燃機関１を上記の直接噴射式ガソリン機関に限定するものではなく、吸気ポートに燃料を噴射する構成の機関であっても良い。機関１からの排気は排気通路７より排出され、該排気通路７には排気浄化用の触媒８が介装されている。また、燃料タンク９にて発生した蒸発燃料を燃焼処理する蒸発燃料処理装置が設

【００３３】尚、前記空燃比フィードバック補正係数ＡＬＰＨＡは、燃料噴射量に乗算される補正項であり、この空燃比フィードバック補正係数ＡＬＰＨＡによって燃料噴射量を増減補正することで、燃料噴射弁５から噴射される燃料とシリンダ内に吸引される空気とで形成される混合気の空燃比を、目標空燃比にフィードバック制御する。

【００３４】図３に示すスライディングモード制御部は、空燃比センサ２７で検出される空燃比と目標空燃比との偏差（空燃比偏差＝実空燃比－目標空燃比）に基づいて線形項Ｕ１を演算する線形項演算部５１１と、前記空燃比偏差に基づいて非線形項Ｕ２を演算する非線形項演算部５１２とを含んで構成され、線形項Ｕ１＋非線形項Ｕ２＝ＡＬＰＨＡとして、前記空燃比フィードバック補正係数ＡＬＰＨＡを出力する。

【００３５】前記線形項演算部５１１は、空燃比偏差×比例ゲイン（＝比例項）、∫（空燃比偏差）×積分ゲイン（＝積分項）、目標空燃比×目標ゲインをそれぞれ演算し、これらの演算結果を総和して線形項Ｕ１を算出するものであり、詳細には、空燃比偏差を$x1$、係数をαi, $a i$, b $(i:1,2,3)$とすると、

$$U1 = 1/b\left((a0-\alpha 3-\alpha 1(a1-\alpha 1))x1-\alpha 3(a1-\alpha 1)\int(x1)+a0r\right)$$

として、線形項Ｕ１を算出する。

【００３６】一方、非線形項演算部５１２は、切換関数をσ、チャタリング防止係数をδ、係数をＫとしたときに、

$$\sigma = \alpha 1 \cdot x1 + d(x1)/dt + \alpha 3\int(x1)$$

$$U2 = K\cdot\sigma/(|\sigma|+\delta)$$

として、非線形項Ｕ２を算出する。

【００３７】上記構成によると、切換え関数σ＝０となる切換え平面上に拘束しつつ、空燃比センサ２７で検出される空燃比を目標空燃比に近づけることになる。ここで、線形項Ｕ１が積分項と比例項との組み合わせによって構成されるから、空燃比の定常偏差を解消することができると共に、補正結果が空燃比センサ２７で検出されるまでの無駄時間による制御安定性の悪化を抑制できる。

【００３８】尚、上記では、実際の空燃比を空燃比センサ２７で検出された排気空燃比としたが、シリンダ内における空燃比を、噴射量や運転条件、更には、空燃比センサ２７の検出結果に基づき推定し、該推定空燃比を実空燃比としてフィードバック制御を行わせる構成であっても良いし、また、排気中の酸素濃度から排気空燃比を検出する空燃比センサ２７に代えて、シリンダ内の空燃比を燃焼光等から検出する空燃比センサを用いる構成であっても良い。

【００３９】図３に示すスライディングモード制御部には、上記線形項演算部５１１及び非線形項演算部５１２と共に、積分ゲイン演算部５１３が備えられる。前記積分ゲイン演算部５１３は、線形項演算部５１１において、積分項の演算に用いられる積分ゲインを演算するものであり、図４のフローチャートに示すようにして、積分ゲインを演算する。

【００４０】図４のフローチャートにおいて、ステップＳ１１では、目標空燃比を読み込み、ステップＳ１２では空燃比センサ２７で検出された実際の空燃比を読み込み、ステップＳ１３では、実空燃比－目標空燃比として空燃比偏差を演算する。そして、ステップＳ１４では、下式に従って積分ゲインを演算する。

積分ゲイン＝｜空燃比偏差｜×定数Ｋｉ

上記のようにして積分ゲインを演算する構成であれば、目標空燃比から実空燃比が離れるほど、より大きな積分ゲインが設定されるから、外乱の投入によって目標空燃比から実空燃比が離れたときに積分項の溜め込みが速く、応答良く目標空燃比に近づけることができ、また、外乱の解除によって補正がオーバーシュートするときには、積分項の吐き出しを速めてオーバーシュートを抑制できる。

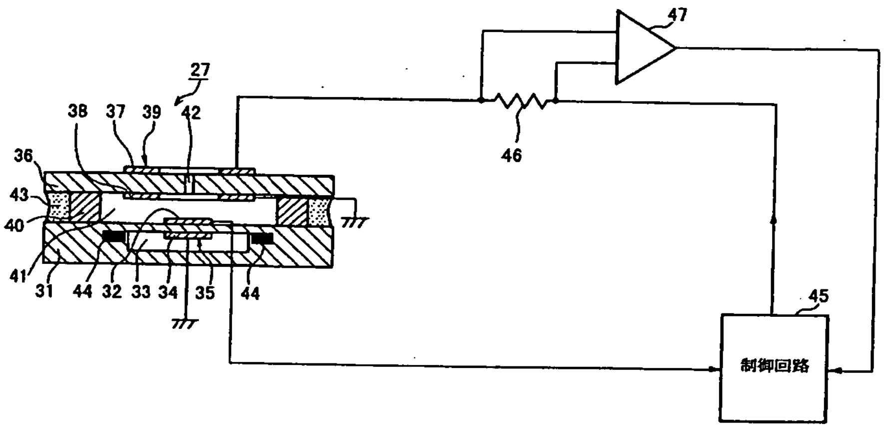
【００４１】前記積分ゲイン演算部５１３における積分ゲインの演算は、図５のフローチャートに示すようにして行わせることもできる。図５のフローチャートにおいて、ステップＳ２１では、目標空燃比を読み込み、ステップＳ２２では空燃比センサ２７で検出された実際の空燃比を読み込み、ステップＳ２３では、実空燃比－目標空燃比として空燃比偏差を演算する。

【００４２】ステップＳ２４では、前記空燃比偏差の変化率を演算する。前記変化率は、最新に演算された空燃比偏差から所定時間前に演算された空燃比偏差を減算して求められる所定時間における偏差の変化量として算出される。ステップＳ２５では、空燃比偏差の符号（プラス・マイナス）と、変化率の符号（プラス・マイナス）とが等しいか否かを判別する。

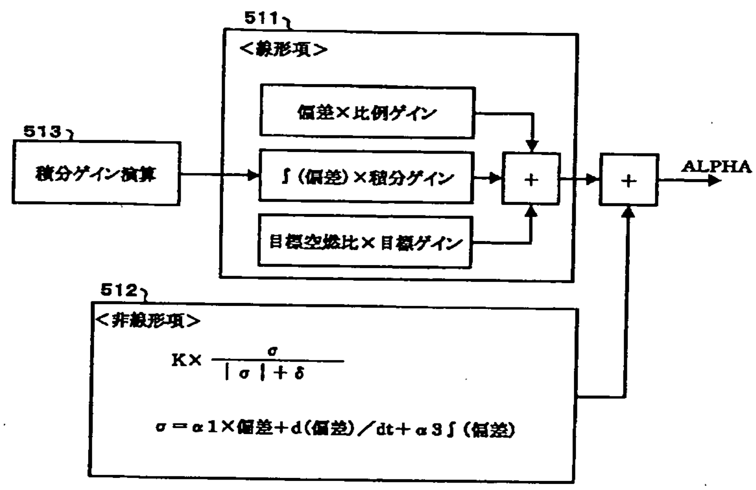
【００４３】例えば、目標空燃比よりも実空燃比がリーンであれば、空燃比偏差はプラスの値として算出され、実空燃比が更にリーン化する傾向であるときには、偏差がより大きくなるから変化率はプラスとなる。従って、空燃比偏差の符号と変化率の符号とが等しい場合とは、目標空燃比から実空燃比が離れつつある状態を示し、逆に、空燃比偏差の符号と変化率の符号とが異なる場合は、実空燃比が目標空燃比に近づきつつある状態を示す。

【００４４】空燃比偏差の符号と変化率の符号とが異なる場合は、ステップＳ２６へ進み、積分ゲインに基準ゲインをセットする。空燃比偏差の符号と変化率の符号とが異なる場合は、前述のように、実空燃比が目標空燃比に近づきつつある状態であるから、過剰な積分ゲインの設定でオーバーシュートが発生することを抑制する。一方、空燃比偏差の符号と変化率の符号とが等しい場合には、ステップＳ２７へ進み、基準ゲインをｘ倍した値

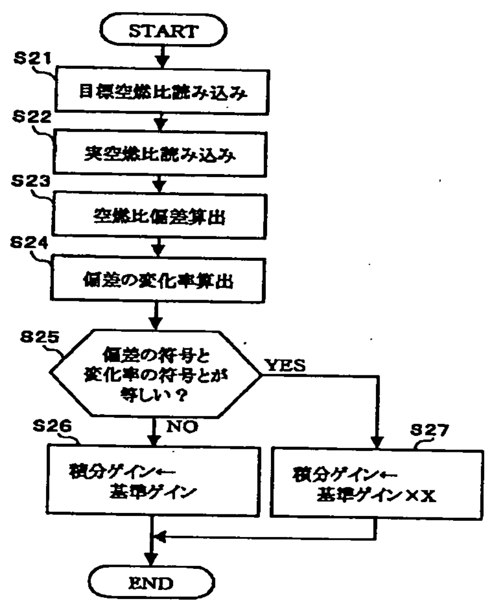
【図２】



【図３】



【図５】



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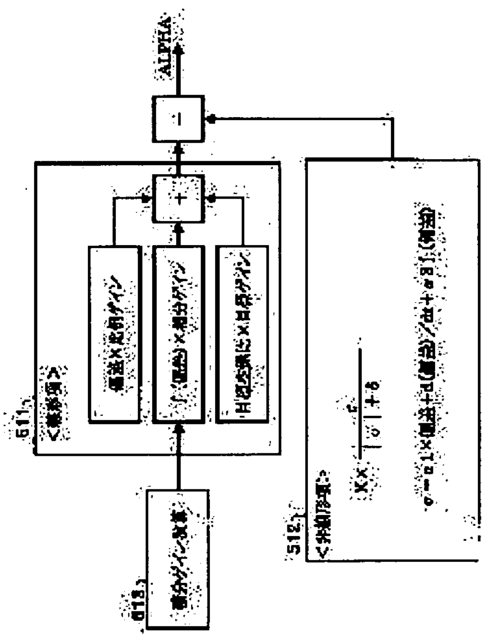
(54) AIR-FUEL RATIO FEEDBACK CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To secure convergence of an air-fuel ratio during input and release of disturbance as a steady deviation is dissolved, in feedback control of an air-fuel ratio using a sliding mode.

SOLUTION: A proportional item is calculated from a deviation between a real air-fuel ratio and a target air-fuel ratio and a proportional gain, an integrating item is calculated from the deviation and an integrating gain, and a total sum of them forms a linear item U1. Meanwhile, a switching function σis set such that an air-fuel ratio deviation, a differential value of a deviation, and an integrating value of a deviation form a variable and a non-linear item U2 is calculated. In this case, in a way that the more an absolute value of the air-fuel ratio deviation is increased, the more the integrating gain is corrected to a higher value, a speed of accumulation of the integrating item when shearing of an air-fuel ratio due to input of disturbance occurs is increased and a speed of discharge of the integrating item when the disturbance is released is increased.



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CLAIMS

[Claim(s)]
[Claim 1] The air-fuel ratio feedback control unit of the internal combustion engine characterized by to constitute so that said linearity term may be computed by the slide modal control based on the detection value of an air-fuel ratio, and a target air-fuel ratio including the integral term computed from the integral value and the integral gain of the deflection of the detection value of an air-fuel ratio, and a target air-fuel ratio in the air-fuel ratio feedback control unit of the internal combustion engine of a configuration of computing the air-fuel ratio feedback controlled variable which comes to contain a linearity term and a nonlinear term.
[Claim 2] The air-fuel ratio feedback control unit of the internal combustion engine according to claim 1 characterized by computing said linearity term including said integral term and the proportional called for by carrying out the multiplication of the proportional gain to said deflection.
[Claim 3] The air-fuel ratio feedback control unit of the internal combustion engine according to claim 1 or 2 characterized by computing said nonlinear term based on the change side which makes a variable the integral value of said deflection and said deflection, and the differential value of said deflection.
[Claim 4] The air-fuel ratio feedback control unit of the internal combustion engine of any one publication of claim 1-3 characterized by amending said integral gain based on said deflection.
[Claim 5] The air-fuel ratio feedback control unit of the internal combustion engine according to claim 4 characterized by amending said integral gain according to the absolute value of said deflection.
[Claim 6] The air-fuel ratio feedback control unit of the internal combustion engine according to claim 5 with which the time when the absolute value of said deflection is larger is characterized by amending said integral gain to a bigger value.
[Claim 7] The air-fuel ratio feedback control unit of the internal combustion engine according to claim 4 characterized by amending said integral gain according to the rate of change of said deflection.
[Claim 8] The air-fuel ratio feedback control unit of the internal combustion engine according to claim 7 characterized by carrying out increase amendment of said integral gain when the sign of said deflection is the same as the sign of the rate of change of said deflection.
[Claim 9] The air-fuel ratio feedback control unit of the internal combustion engine according to claim 8 with which the time when the absolute value of the rate of change of said deflection is larger is characterized by carrying out increase amendment of said integral gain more greatly.
[Claim 10] The air-fuel ratio feedback control unit of the internal combustion engine according to claim 4 characterized by amending said integral gain according to the rate of change of the absolute value of said deflection.

[Translation done.]

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention -- an internal combustion engine's air-fuel ratio feedback control device -- being related -- especially -- slide modal control -- using -- combustion -- it is related with the technique which carries out feedback control of the air-fuel ratio of gaseous mixture to a target air-fuel ratio.
[0002]
[Description of the Prior Art] Although slide modal control is known as high control of the robustness which controlled the effect of disturbance and it is used abundantly by robot control etc. from the former, performing feedback control of an air-fuel ratio using this slide modal control is proposed (reference, such as JP,8-232713,A).
[0003]
[Problem(s) to be Solved by the Invention] However, in the feedback control of air-fuel ratio by the conventional slide mode, since it was the configuration which a linearity term calculates according to the deflection to a target air-fuel ratio, when there was a steady air-fuel ratio gap, there was a problem that the amendment which cancels this steady-state deviation could not be added.
[0004] Moreover, the problem that big air-fuel ratio deflection will arise by unnecessary amendment being made after the integral term saved up by air-fuel ratio fluctuation by the injection of disturbance does not decrease easily even if disturbance was canceled, but disturbance is canceled if integral control action is made to perform feedback control in the feedback control by the usual proportional plus integral plus derivative action occurs.
[0005] This invention is made in view of the above-mentioned trouble, and it aims at enabling it to cancel the steady-state deviation of an air-fuel ratio in the feedback control of air-fuel ratio by slide mode. Furthermore, it aims at enabling it to control air-fuel ratio fluctuation when disturbance is canceled, canceling the steady-state deviation of an air-fuel ratio.
[0006]
[Means for Solving the Problem] Therefore, in the air-fuel ratio feedback control unit of the internal combustion engine of a configuration of computing the air-fuel ratio feedback controlled variable which comes to contain a linearity term and a nonlinear term by the slide modal control based on the detection value of an air-fuel ratio and a target air-fuel ratio, said linearity term constituted invention according to claim 1 so that it might be computed including the integral term computed from the integral value and integral gain of the deflection of the detection value of an air-fuel ratio, and a target air-fuel ratio.
[0007] According to this configuration, the integral term computed from the integral value and integral gain of air-fuel ratio deflection is included in a linearity term, and an amendment demand for this integral term to cancel steady-state deviation is held. In invention according to claim 2, said linearity term considered as the configuration computed including said integral term and the proportional called for by carrying out the multiplication of the proportional gain at said deflection.
[0008] According to this configuration, the proportional called for with said integral term as a linearity term by carrying out the multiplication of the proportional gain to air-fuel ratio deflection is contained, and the aggregate value of an integral term and a proportional is made into a linearity term. In invention according to claim 3, said nonlinear term considered as the configuration computed based on the change side which makes a variable the integral value of said deflection and said deflection, and the differential value of said deflection.

[0009] According to this configuration, it is restrained on the change side which makes a variable the integral value of deflection and deflection, and the differential value of deflection, and is controlled to slide towards a target air-fuel ratio. In invention according to claim 4, it considered as the configuration which amends integral gain based on air-fuel ratio deflection. According to this configuration, the integral gain by which multiplication is carried out to the integral value of air-fuel ratio deflection is not fixed, it is amended according to air-fuel ratio deflection, and integral gain is changed from the information on the deflection of a real air-fuel ratio, or the direction of change over a target air-fuel ratio.
[0010] In invention according to claim 5, it considered as the configuration which amends integral gain according to the absolute value of air-fuel ratio deflection. According to this configuration, integral gain is amended [rich or] for a real air-fuel ratio by whether it is separated only from which in the direction of Lean to a target air-fuel ratio. In invention according to claim 6, the time when the absolute value of air-fuel ratio deflection is larger was considered as the configuration which amends integral gain to a bigger value.
[0011] According to this configuration, in the time of the real air-fuel ratio being greatly [richly] more nearly separated in the direction of Lean to the target air-fuel ratio, integral gain is amended greatly and the absolute value of the integral term acquired to the integral value of air-fuel ratio deflection becomes large. In invention according to claim 7, it considered as the configuration which amends integral gain according to the rate of change of air-fuel ratio deflection.
[0012] According to this configuration, integral gain is amended according to the rate of change of the air-fuel ratio deflection which shows the change direction and change rate of a real air-fuel ratio to a target air-fuel ratio. In addition, said rate of change is the variation per unit time amount of air-fuel ratio deflection. In invention according to claim 8, when the sign of air-fuel ratio deflection was the same as the sign of the rate of change of air-fuel ratio deflection, it considered as the configuration which carries out increase amendment of the integral gain.
[0013] According to this configuration, for example, rather than a target air-fuel ratio, although a real air-fuel ratio is Lean, a real air-fuel ratio is in the condition which is carrying out Lean change further, it is in the condition which has air-fuel ratio deflection in the inclination to expand, and, as for the condition that the sign of air-fuel ratio deflection and the sign of rate of change are the same, increase amendment of the integral gain is carried out in the condition of starting. In invention according to claim 9, the time when the absolute value of the rate of change of air-fuel ratio deflection is larger was considered as the configuration which carries out increase amendment of the integral gain more greatly.
[0014] When it is in the inclination which air-fuel ratio deflection expands according to this configuration, the time when the rate which separates from a target air-fuel ratio is quicker carries out increase amendment of the integral gain. In invention according to claim 10, it considered as the configuration which amends integral gain according to the rate of change of the absolute value of air-fuel ratio deflection. According to this configuration, the air-fuel ratio deflection to a target air-fuel ratio is called for by calculating the absolute value of air-fuel ratio deflection regardless of whether a real air-fuel ratio is rich to a target air-fuel ratio, or you are Lean. If the rate of change of the absolute value of this deflection is plus, air-fuel ratio deflection will be expanded, if it is minus conversely, air-fuel ratio deflection will contract, it will change toward a target air-fuel ratio, and integral gain will be changed according to this.
[0015]
[Effect of the Invention] According to invention according to claim 1, it is effective in the steady-state deviation of an air-fuel ratio being cancelable, making high control of the robustness which controlled the effect of disturbance perform by including an integral term in the linearity term in slide modal control. According to invention according to claim 2, while steady-state deviation is cancelable by making a linearity term compute from a proportional and an integral term, it is effective in the stability in feedback control of air-fuel ratio with much dead time being securable.
[0016] According to invention according to claim 3, it is effective in the ability to bring close to a target air-fuel ratio, maintaining the integral value of air-fuel ratio deflection and air-fuel ratio deflection, and the differential value of air-fuel ratio deflection at predetermined equilibrium. According to invention according to claim 4, it is effective in the ability for a setup of the proper integral gain according to fluctuation of a real air-fuel ratio to be attained, and for an integral term save up, make - discharge rate the optimal, and raise the convergency to a target air-fuel ratio by amending the integral gain used for the operation of an integral term according to air-fuel

ratio deflection.
[0017] According to invention of claim 5 and six publications, by enlarging integral gain, so that a real air-fuel ratio separates to a target air-fuel ratio, an integral term saves up, and it speeds up [- discharge], and is effective in the ability to return a real air-fuel ratio with a sufficient response to a target air-fuel ratio. according to invention according to claim 7 -- the information on the change direction and change rate of air-fuel ratio deflection -- being based -- integral gain -- proper -- it can amend -- with -- **** -- it is effective in the ability for an integral term to save up, make - discharge rate the optimal, and raise the convergency to a target air-fuel ratio.
[0018] According to invention of claims 8 and 9 and ten publications, when air-fuel ratio deflection is in an expansion inclination, integral gain is amended greatly, an integral term saves up, - discharge rate is made quick, and it is effective in the ability to complete a real air-fuel ratio as a target air-fuel ratio promptly.
[0019]
[Embodiment of the Invention] The gestalt of operation of this invention is explained below. Drawing 1 is an internal combustion engine's system configuration Fig. in the gestalt of operation. In this drawing 1 , air is inhaled in the combustion chamber of each gas column of the internal combustion engine 1 carried in a car through the electronics control type throttle valve 4 by which a closing motion drive is carried out by the air cleaner 2, the inhalation-of-air path 3, and the motor.
[0020] The electromagnetic fuel injection valve 5 which injects a fuel (gasoline) directly is formed in the combustion chamber of each gas column, and gaseous mixture is formed in a combustion chamber of the fuel injected from this fuel injection valve 5, and said air inhaled. A fuel injection valve 5 is energized to a solenoid by the injection pulse signal outputted from a control unit 20, opens, and injects the fuel whose pressure was regulated by the predetermined pressure. And in injection of an inhalation-of-air line, the injected fuel is spread in a combustion chamber, and forms homogeneous gaseous mixture, and, in compression stroke injection, layer-like gaseous mixture is intensively formed in the circumference of an ignition plug 6. The gaseous mixture formed in a combustion chamber carries out ignition combustion by the ignition plug 6.
[0021] However, you may be the engine of a configuration of injecting a fuel not to the thing which limits an internal combustion engine 1 to the above-mentioned direct injection gasoline engine but to a suction port. The exhaust air from an engine 1 is discharged from a flueway 7, and the catalyst 8 for exhaust air purification is infixed in this flueway 7. Moreover, the evaporation fuel processing unit which carries out combustion processing of the evaporation fuel generated in the fuel tank 9 is formed.
[0022] A canister 10 is what was filled up with the adsorbents 11, such as activated carbon, in the well-closed container, and the evaporation fuel installation tubing 12 installed from a fuel tank 9 is connected. Therefore, the evaporation fuel generated in the fuel tank 9 passes along said evaporation fuel installation tubing 12, and adsorption uptake is led and carried out to a canister 10. Moreover, while the new air conduction inlet port 13 is formed, the purge piping 14 is drawn and the purge control valve 15 by which closing motion is controlled by the control signal from a control unit 20 is infixed in said purge piping 14 at a canister 10.
[0023] In the above-mentioned configuration, if open control of the purge control valve 15 is carried out, as a result of an engine's 1 inhalation negative pressure acting on a canister 10, the evaporation fuel by which the adsorbent 11 of a canister 10 was adsorbed is purged, purge air is inhaled through the purge piping 14 on throttle-valve 4 lower stream of a river of the inhalation-of-air path 3, and combustion processing is carried out after that by an engine's 1 combustion chamber by the air introduced from the new air conduction inlet port 13.
[0024] A control unit 20 is equipped with the microcomputer constituted including CPU, ROM, RAM, an A/D converter, an input/output interface, etc., receives the input signal from various sensors, it carries out data processing based on these, and it controls actuation of a fuel injection valve 5, an ignition plug 6, the purge control valve 15, etc. As said various sensors, the cam sensor 22 which takes out a gas column distinction signal is formed from the crank angle sensor 21 which detects an engine's 1 crank angle, and the cam shaft, and an engine's rotational speed Ne is computed based on the signal from said crank angle sensor 21.
[0025] In addition to this By the throttle-valve 4 upstream of the inhalation-of-air path 3, an intake air flow Q A (mass flow rate) The air flow meter 23, the amount of treading in of an accelerator pedal to detect (Accelerator opening) APS The opening TVO of the accelerator sensor 24 to detect and a throttle valve 4 the oxygen density under the throttle sensor 25 to detect, the coolant temperature sensor 26 which detects an engine's 1 cooling water temperature Tw, and exhaust air -- responding -- combustion -- the air-fuel ratio sensor 27 of the broader-

based mold which detects the air-fuel ratio of gaseous mixture to a linear, the speed sensor 28 which detects the vehicle speed VSP are formed.

[0026] Here, the structure of said broader-based type of air-fuel ratio sensor 27 is explained based on drawing 2 . On the substrate 31 which consists of solid electrolyte members, such as a zirconia (ZrO_2), the + electrode 32 for oxygen density measurement is formed. Moreover, in said substrate 31, the centrum 33 into which atmospheric air is introduced is established, it is attached in the head-lining section of this centrum 33 so that the - electrode 34 may counter the + electrode 32 on both sides of a substrate 31, and the oxygen density detecting element 35 is formed with said substrate 31, + electrode 32, and - electrode 34.

[0027] Moreover, it has the oxygen-pumping section 39 which forms the pump electrodes 37 and 38 which consist of platinum of a pair in both sides of the solid electrolyte member 36 which consists of a zirconia etc., and is formed in them. And the introductory hole 42 for carrying out a laminating above the oxygen density detecting element 35 through the spacer 40 formed in the shape of a frame with the alumina, and the hollow room 41 being formed between the oxygen density detecting element 35 and the oxygen-pumping section 39, and introducing an engine's exhaust air into this hollow room 41 is formed in the solid electrolyte member 36 of the oxygen-pumping section 39 in this oxygen-pumping section 39.

[0028] In addition, while the periphery of said spacer 40 is filled up with the glass adhesives 43 and securing the sealing nature of the hollow room 41, it has been made to carry out adhesion immobilization of a substrate 31 and a spacer 40, and the solid electrolyte 36. Here, since a spacer 40 and a substrate 31 carry out coincidence baking and it is combined, the sealing nature of the hollow room 41 is secured by pasting up a spacer 40 and the solid electrolyte member 36. Moreover, the heater 44 for heating is built in the oxygen density detecting element 39.

[0029] And the oxygen density of the exhaust air introduced into the hollow room 41 through the introductory hole 42 is detected from the electrical potential difference of the aforementioned + electrode 32. According to the concentration difference of the oxygen in the atmospheric air in a centrum 33, and the oxygen under exhaust air in the hollow room 41, oxygen ion flows and, specifically, the electromotive force corresponding to the oxygen density under exhaust air to the + electrode 32 generates the inside of a substrate 31 in connection with this. And it responds to this detection result and is regularity (for example, theoretical air fuel ratio) about the ambient atmosphere in the hollow room 41. The current value passed in the oxygen-pumping section 39 is controlled to maintain, and the oxygen density under exhaust air (exhaust air air-fuel ratio) is detected from the current value at that time.

[0030] After carrying out magnification processing of the electrical potential difference of the aforementioned + electrode 32 by the control circuit 45, it impresses between an electrode 37 and 38 through the electrical-potential-difference detection resistance 46, and, specifically, the oxygen density in the hollow room 41 is kept constant. For example, in detecting the air-fuel ratio in the high Lean field of the oxygen density under exhaust air, an anode plate and the pump electrode 38 by the side of the hollow room 41 are used as cathode for the outside pump electrode 37, and it impresses an electrical potential difference. Then, the oxygen (oxygen ion $O2-$) proportional to a current is pumped out of the hollow room 41 outside. and the thing for which the flowing current will reach threshold value and this limiting current value will be measured in said control circuit 45 if applied voltage becomes beyond a predetermined value -- the oxygen density under exhaust air -- if it puts in another way, an exhaust air air-fuel ratio is detectable.

[0031] On the contrary, if the pump electrode 37 is made as cathode, the pump electrode 38 is made into an anode plate and oxygen is poured in into the hollow room 41, air-fuel ratio detection in the low air-fuel ratio rich field of the oxygen density under exhaust air can be performed. The above-mentioned limiting current is detected from the output voltage of the differential amplifier 47 which detects the electrical potential difference between terminals of said electrical-potential-difference detection resistance 46.

[0032] When a predetermined air-fuel ratio feedback control condition is satisfied, said control unit 20 performs feedback control of air-fuel ratio by slide mode so that it may make in agreement with a target air-fuel ratio the exhaust air air-fuel ratio detected by the above-mentioned air-fuel ratio sensor 27. The control-block Fig. of drawing 3 shows the configuration of the slide mode control section which calculates the air-fuel ratio feedback correction factor ALPHA with slide mode.

[0033] In addition, said air-fuel ratio feedback correction factor ALPHA is a correction term by which multiplication is carried out to fuel oil consumption, is carrying out increase and decrease of the fuel oil

consumption of amendment with this air-fuel ratio feedback correction factor ALPHA, and carries out feedback control of the air-fuel ratio of the gaseous mixture formed with the fuel injected from a fuel injection valve 5, and the air attracted in a cylinder to a target air-fuel ratio.
[0034] The linearity term operation part 511 which calculates the linearity term U1 based on the deflection (air-fuel ratio deflection = real air-fuel ratio-target air-fuel ratio) of the air-fuel ratio and target air-fuel ratio with which the slide mode control section shown in drawing 3 is detected by the air-fuel ratio sensor 27, It is constituted including the nonlinear term operation part 512 which calculates the nonlinear term U2 based on said air-fuel ratio deflection, and said air-fuel ratio feedback correction factor ALPHA is outputted as linearity term U1+ nonlinear term U2=ALPHA.
[0035] Said linearity term operation part 511 Air-fuel ratio deflection x proportional gain (= proportional), It is what computes the linearity term U1 by calculating integral(air-fuel ratio deflection) x integral gain (= integral term) and target air-fuel ratio x target gain, respectively, and totaling these results of an operation. In a detail If air-fuel ratio deflection is set to x1 and a multiplier is set to alphai, and ai and b (2 i:1, 3), the linearity term U1 will be computed as U1=1/b (a0-alpha3-alpha1 (a1-alpha1)) (x1-alpha3 (a1-alpha1) integral(x1)+a0r).
[0036] On the other hand, the nonlinear term operation part 512 is sigma=alpha1andx1+d
(x1) /dt+alpha3integral (x1), when sigma and a chattering prevention multiplier are set to delta and it sets a multiplier to K for a change-over function.
U2=K-sigma/(|sigma|+delta)
The nonlinear term U2 is computed by carrying out.
[0037] The air-fuel ratio detected by the air-fuel ratio sensor 27 will be brought close to a target air-fuel ratio, restraining on the change flat surface used as change function sigma=0 according to the above-mentioned configuration. Here, since the linearity term U1 is constituted by the combination of an integral term and a proportional, while the steady-state deviation of an air-fuel ratio is cancelable, aggravation of the control stability by the dead time until an amendment result is detected by the air-fuel ratio sensor 27 can be controlled.
[0038] In addition, although the actual air-fuel ratio was made into the exhaust air air-fuel ratio detected by the air-fuel ratio sensor 27 in the above the air-fuel ratio in a cylinder -- the injection quantity and a service condition -- further May be the configuration of presuming based on the detection result of the air-fuel ratio sensor 27, and making feedback control performing by making this presumed air-fuel ratio into a real air-fuel ratio, and Moreover, you may be a configuration using the air-fuel ratio sensor which replaces with the air-fuel ratio sensor 27 which detects an exhaust air air-fuel ratio from the oxygen density under exhaust air, and detects the air-fuel ratio in a cylinder from combustion light etc.
[0039] The slide mode control section shown in drawing 3 is equipped with the integral gain operation part 513 with the above-mentioned linearity term operation part 511 and the nonlinear term operation part 512. In the linearity term operation part 511, said integral gain operation part 513 calculates the integral gain used for the operation of an integral term, and as it is shown in the flow chart of drawing 4 , it calculates integral gain.
[0040] In the flow chart of drawing 4 , at step S11, a target air-fuel ratio is read, the actual air-fuel ratio detected by the air-fuel ratio sensor 27 at step S12 is read, and air-fuel ratio deflection is calculated as a real air-fuel ratio-target air-fuel ratio at step S13. And at step S14, integral gain is calculated according to a bottom type. Integral gain = if it is the configuration of calculating integral gain as it is the | air-fuel ratio deflection |x constant Ki above Since bigger integral gain is set up so that a real air-fuel ratio separates from a target air-fuel ratio When an accumulate lump of an integral term is quick when a real air-fuel ratio separates from a target air-fuel ratio by the injection of disturbance, and it can bring with a sufficient response close to a target air-fuel ratio and amendment overshoots by discharge of disturbance, the discharge of an integral term is sped up and overshoot can be controlled.
[0041] As the operation of the integral gain in said integral gain operation part 513 is shown in the flow chart of drawing 5 , it can also be made to perform. In the flow chart of drawing 5 , at step S21, a target air-fuel ratio is read, the actual air-fuel ratio detected by the air-fuel ratio sensor 27 at step S22 is read, and air-fuel ratio deflection is calculated as a real air-fuel ratio-target air-fuel ratio at step S23.
[0042] At step S24, the rate of change of said air-fuel ratio deflection is calculated. Said rate of change is computed as variation of the deflection in the predetermined time which subtracts the air-fuel ratio deflection calculated before predetermined time from the air-fuel ratio deflection calculated to the newest, and is found. At step S25, it distinguishes whether the sign (plus minus) of air-fuel ratio deflection and the sign (plus minus) of

rate of change are equal.
[0043] For example, rather than a target air-fuel ratio, if a real air-fuel ratio is Lean, air-fuel ratio deflection is computed as a value of plus, and when it is the inclination which a real air-fuel ratio Lean-izes further, since deflection becomes larger, rate of change will be added. Therefore, the condition that a real air-fuel ratio is separated from a target air-fuel ratio when the sign of air-fuel ratio deflection and the sign of rate of change are equal is shown, and conversely, when the sign of air-fuel ratio deflection differs from the sign of rate of change, a real air-fuel ratio shows the condition of approaching a target air-fuel ratio.
[0044] When the sign of air-fuel ratio deflection differs from the sign of rate of change, it progresses to step S26 and criteria gain is set to integral gain. When the sign of air-fuel ratio deflection differs from the sign of rate of change, since a real air-fuel ratio is in the condition of approaching a target air-fuel ratio, it controls that overshoot occurs in a setup of superfluous integral gain as mentioned above. On the other hand, when the sign of air-fuel ratio deflection and the sign of rate of change are equal, it progresses to step S27 and the value which doubled criteria gain x is made into the integral gain at that time.
[0045] Here, although said x times may be a fixed value, it is desirable to make it change according to the absolute value of rate of change, and, specifically, they is good for the time when the absolute value of rate of change is larger to enlarge Multiple x. When the sign of air-fuel ratio deflection and the sign of rate of change are equal, it is in the condition which air-fuel ratio deflection is expanding, and an accumulate lump of an integral term can be made quick, and the air-fuel ratio fluctuation by disturbance can be promptly completed at the time of a disturbance injection, if integral gain is amended to a bigger value at this time and disturbance is canceled, the discharge of an integral term is sped up and generating of overshoot can be controlled.
[0046] In addition, the absolute value of air-fuel ratio deflection is calculated, and when the rate of change of the absolute value of this air-fuel ratio deflection is plus, substantially, the time when the rate of change of the absolute value of the fixed multiple x or air-fuel ratio deflection is larger becomes the same as processing according to the flow chart of drawing 5 also as a configuration which increases criteria gain by the multiple x set as a big value.

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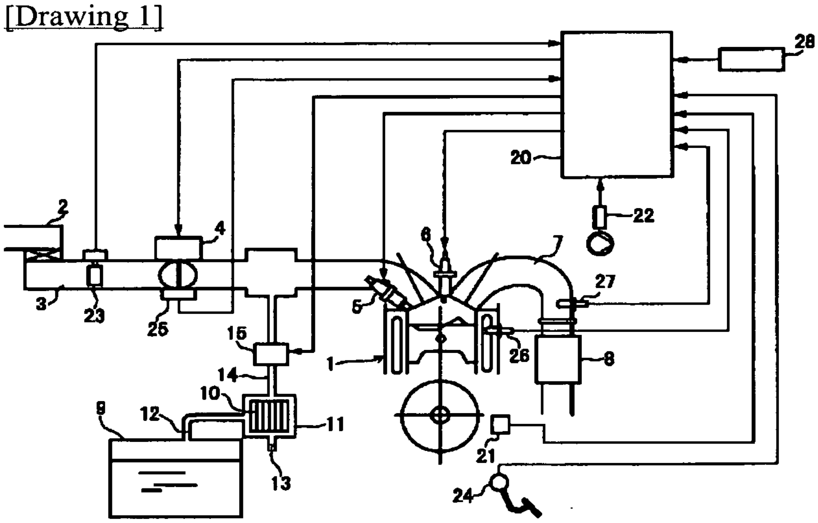
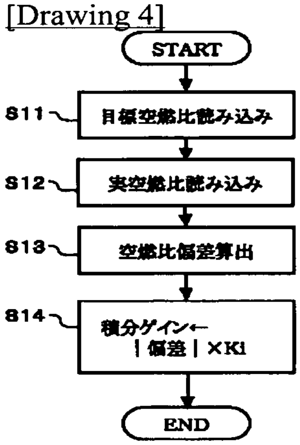
DRAWINGS

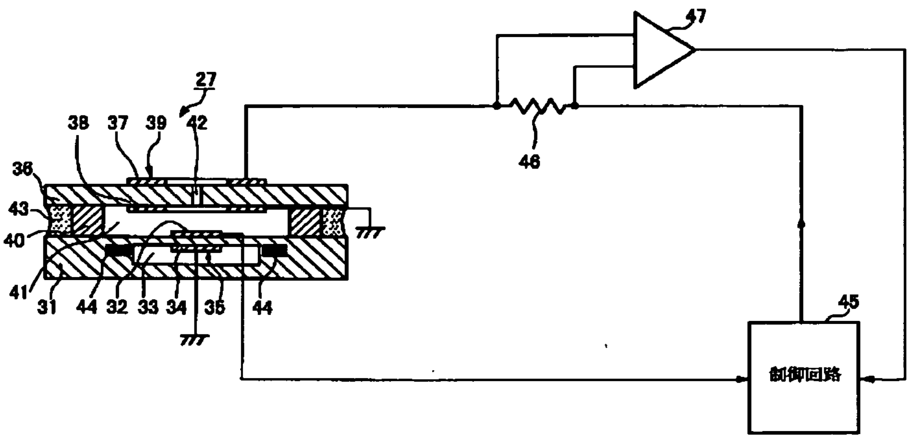
[Drawing 1]



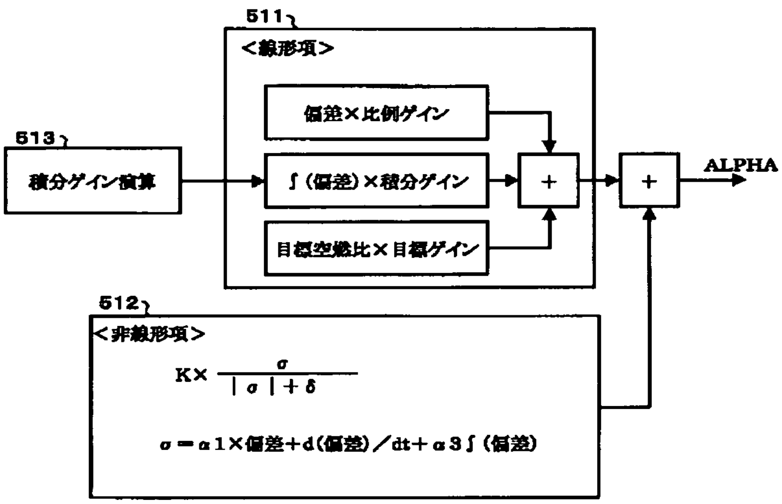
[Drawing 4]



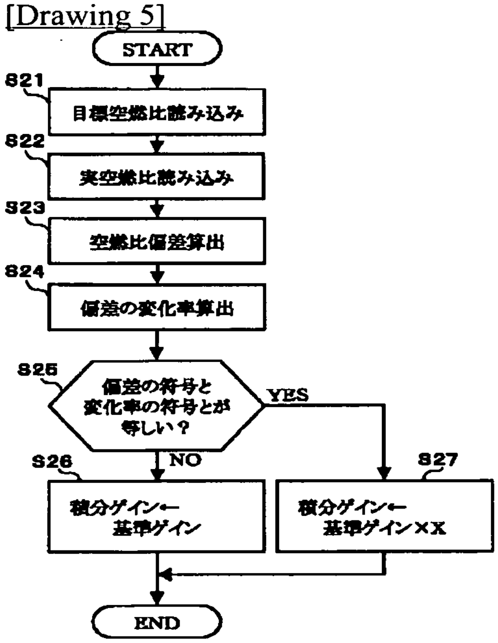
[Drawing 2]



[Drawing 3]



[Drawing 5]



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